



A study of neurocysticercosis in the foothills of the Himalayas

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KEYWORDS

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Summary

Objectives: The present study was planned and carried out with the aim of determining the incidence of neurocysticercosis (NCC) among patients with clinically manifested neurological disorders attending the Himalayan Institute of Medical Sciences (HIMS) hospital.

Methods: Spanning a period of 18 months, serum samples of consecutively selected patients were screened by ELISA for the presence of anti-cysticercus antibodies after obtaining a detailed history. Physical examinations were performed along with routine hematological, stool and urine tests. All patients included in the study group were also subjected to radiological investigations such as CT scan/MRI/X-ray and/or ultrasonography.

Results: One hundred and three new patients were selected for the study group, with a male:female ratio of 2:1. Of these, 33 (32.0%) patients were positive for *Taenia solium* IgG antibodies in sera. Children in the 11–20 years age group were most affected (39.4%). Only 10 patients (30.3%) were found to be positive for ova in stool, which correlated well with the presence of multiple lesions in the central nervous system ($p < 0.01$). Solitary lesions were more common (66.7%) than multiple lesions (33.3%) on radiological diagnosis by CT scan/MRI.

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Conclusions: A high incidence of neurocysticercosis in the region reflects the endemic presence of *T. solium* and advocates the practice of better hygiene, cooking methods and water filtration procedures for the prevention of infection.

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Introduction

Cysticercosis caused by infection with *Taenia solium* is widely reported in various parts of India. Complications of the disease include a neurologic infestation usually brought about by ingestion of eggs. Neurocysticercosis (NCC) presents a unique problem, as it is an end stage infection, accidental in man with a benign natural course.¹ A cause of severe morbidity and mortality, NCC remains endemic in the northern hilly regions of Uttaranchal, India. The objective of the present study was to find out the incidence of NCC among patients with clinically manifested neurological disorders reporting to the out-patient departments and in-patient departments of the Himalayan Institute of Medical Sciences (HIMS).

Materials and methods

Consecutively selected patients attending the out-patient departments or admitted to the in-patient wards of HIMS, Dehradun from July 2002 to December 2003 with first-time neurological manifestations, were included in the study group.

Patients included in the study group were previously undiagnosed, reporting to the hospital with neurological manifestations such as seizures, convulsions, fainting attacks, recurrent headaches, focal neurological deficits, signs of meningitis and dementia. They also included patients with a history of trauma following a fainting attack or seizure but clinically not suggestive of a cerebrovascular accident.

Patients excluded from the study group were previously diagnosed cases of NCC undergoing treatment, or reporting for follow-up in the hospital. Other exclusions were clinically diagnosed cases of cerebrovascular accident (CVA) e.g., transient ischaemic attacks and stroke, and also paranaal hypoxia and ischaemia or intracranial birth injuries in the case of infants. Patients with a history of alcoholism or trauma following alcohol intake, and previously diagnosed cases of chronic renal failure, hepatic failure, or electrolyte abnormalities were also excluded.

All patients included in the study group were subjected to detailed history-taking and an examination session following a planned protocol. History

of seizures, fainting attacks, headache, recent development of subcutaneous or muscular nodules, food habits, occupation and previous medication were elicited in detail. A thorough general and systemic physical examination was carried out with emphasis on the nervous system.

Routine investigations such as hematological parameters (hemoglobin, total leucocyte count, differential leucocyte count, erythrocyte sedimentation rate, absolute eosinophil count), urine examination and chest X-rays were carried out on each patient. All the patients included in the study group were subjected to radiological investigations such as CT scan and brain MRI or other supplementary X-ray/ultrasonographic examinations based on associated complaints.

Stool examination of all the patients was carried out on three consecutive days. Stool was concentrated using the sedimentation–centrifugation technique. Saline and iodine wet mount preparations were examined to screen for trophozoites, ova or cysts.

Serum from each patient included in the group was subjected to screening with *T. solium* microwell ELISA using positive and negative controls (KIT: IVD Research Inc., Carlsbad, CA, USA).

Results

A total of 103 new patients presenting with neurological symptoms were included in the study group. The male to female ratio of the patients among the study group was 2:1. All the selected patients were screened for the presence of anti-*T. solium* IgG antibodies in sera and only 33 (32.0%) were found to be positive.

A total of 33 (32.0%) patients were found to be suffering with neurocysticercosis; 17 (16.5%) male and 16 (15.5%) female, the ratio being almost 1:1 (Table 1). The difference among males and females was not statistically significant ($p > 0.05$).

In dietary terms 33.3% were vegetarians while 66.7% were non-vegetarians, of whom 20% were pork eaters. The greatest number of patients were found to be in the 11–20 years age group (39.4%), followed by the 0–10 years age group (27.3%), in both males and females (Table 2).

The common spectrum of clinical features manifested among the seropositive NCC patients are

Table 1 Gender distribution of patients, with and without NCC, included in the study group ($n = 103$).

Diagnosis	Males	Females	Total	Percentage
Without NCC	52 (50.5%)	18 (17.5%)	70	68.0
NCC	17 (16.5%)	16 (15.5%)	33	32.0
Total	69 (67.0%)	34 (33.0%)	103	100

χ^2 test = 3.2; $p \geq 0.05$. NCC, neurocysticercosis.

summarized in Table 3 and contrasted with the seronegative patients. On stool examination after concentration, only 10 (30.3%) out of 33 ELISA positive patients, indicating taeniasis (Table 4) were found to be positive for the presence of *T. solium* eggs.

Intestinal taeniasis was correlated with the lesions found in the central nervous system (CNS). It was observed that 21.2% of patients with multiple lesions in the CNS were harboring the parasite in the intestine, whereas only 9.1% of patients with a solitary lesion in the CNS were positive for eggs in the stool. In spite of these observations the larger number (69.7%) of patients with NCC did not present with eggs in stool. These observations were statistically significant ($p < 0.01$).

Radiological evidence was found to be present by CT scan and MRI in all 33 patients. A single lesion was found in 22 (66.7%) patients and multiple lesions in only 11 (33.3%) patients. Most of the lesions were parenchymal in location (84.8%) and interventricular lesions were detected in six (18.2%) patients only. Midline shift was observed in only one (3.0%) patient.

Discussion

Cysticercosis has been found to be highly endemically present in the region of Garhwal which is located in the northern state of Uttaranchal in India. Many rural households rear pigs in small numbers, providing the family not only with a means of income but also meat. In the absence of a sanitary infrastructure, people use open areas and fields for defecation. Free ranging pigs thus have access to human faeces, which perpetuates transmission of

the parasite from human to pig. The pork being sold to customers is not thoroughly inspected because of the threat of condemnation and taxation. Local culinary habits also encourage the consumption of raw or partly-cooked meat.^{2,3}

Other researchers in this northern state of India report neurocysticercosis affecting between 3.9% and 9.7% of the general population.^{4,5} Our study indicates the incidence rate of neurocysticercosis to be 32.0% among patients clinically presenting with neurological symptoms such as headaches, seizures, fainting episodes, focal neurological deficits, dementia and similar complaints.

Both sexes were found to be almost equally affected (1:1). A large number of patients were found to be vegetarians (33%) as the infection is commonly acquired by the ingestion of eggs along with contaminated food and water. The larger group (66%) of patients were either pork eaters or were directly or indirectly involved with pig farming. Similar studies conducted in the region mention that neurocysticercosis is common among vegetarians as well as non-vegetarians (both pork eaters and non-pork eaters).^{4,5}

Radiological analyses using modalities such as CT and MRI scans are used worldwide for accurate diagnosis, with varying results.^{6–10} Perilesional edema and rim enhancement were easily visualized on radiological analysis and correlated well with the diagnosis of the disease.⁷ Images provided by MRI were better for evaluation of patients with intraventricular cysticercosis, brain stem cysts and small cysts located with convexity of cerebral hemispheres,

Table 2 Demographic analysis of patients with neurocysticercosis ($n = 33$).

Age Group	Males (%)	Females (%)	Total (%)
0–10 years	6 (18.2)	3 (9.1)	9 (27.3)
11–20 years	5 (15.2)	8 (24.2)	13 (39.4)
21–30 years	2 (6.1)	2 (6.1)	4 (12.1)
31–40 years	1 (3.0)	2 (6.1)	3 (9.1)
41–50 years	2 (6.1)	0	2 (6.1)
51–60 years	1 (3.0)	1 (3.0)	2 (6.1)
Total	17	16	33 (100)

Table 3 Analysis of observed clinical features in the study group.

Symptoms	Seropositive patients ($n = 33$)	Seronegative patients ($n = 70$)
Generalized seizures	72.7%	77.1
Focal seizures	18.2%	5.7
Localizing neurological signs	12.1%	2.9
Meningitis	3.0%	4.3
Headache	42.4%	68.6
Subcutaneous nodules	6.1%	4.3
Dementia	3.1%	7.1

Table 4 Correlation of detected cysticercus lesions in CNS with intestinal taeniasis (detection of eggs in stool) in the neurocysticercosis diagnosed patients ($n = 33$).

Lesions in CNS	With taeniasis (%)	Without taeniasis (%)	Total	Percentage
Multiple	7 (21.2)	4 (12.1)	11	33.3
Solitary	3 (9.1)	19 (57.6)	22	66.7
Total	10 (30.3)	23 (69.7)	33	100

(χ^2 test = 9.84; $p \leq 0.01$).

although CTscans remain the best available screening neuroimaging technique.¹¹

Immunological assays detected positivity for human cysticercosis at 8–12% in endemic areas.⁸ Serological analysis by ELISA was able to detect all cases in patients (100%), although a cerebrospinal fluid ELISA has been advocated by a few researchers who have found it to be more sensitive and specific.¹²

The correlation between positive serology and neurological symptoms, and/or lesions indicative for neurocysticercosis on neuroimaging techniques, is poor to fair in most studies.^{13–18} However, in the present study the correlation obtained between ELISA and imaging was 100%. All the cases detected on imaging were found to be positive by serological analysis. The stool examination was positive only in a few cases.

Conclusions

The present study reiterates that a fresh approach needs to be formulated for the control of neurocysticercosis in the region of Garhwal in Uttaranchal, North India as the disease is endemically present with a high incidence rate. The common age group affected is below 20 years of age as the precautions observed by this younger generation are frequently minimal. Although the disease is detected on imaging and immunological analysis, both facilities being available at the hospital, ELISA remains the most convenient modality for diagnosis at centers lacking advanced imaging techniques.

Conflict of interest: No conflict of interest to declare.

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